**Concert Laser Beams Task**

**This task will be assessed against criteria A and C.**

A concert stage has a parabolic roof. The front edge of the roof is defined by the equation , where is the horizontal distance from the centre and is the height, both in metres. A vertical lighting tower is build at . Coloured laser lights are installed at various intervals going up the tower. The beams of light are to shine on the front edge of the roof, with their paths defined by the following equations:

Blue:

Green:

Orange:

Red:

1. Using Geogebra draw the graph of .
2. Determine the coordinates of any point(s) of intersection;
3. algebraically; and
4. graphically

of each laser beam with the edge of the roof.

1. All but one of these laser beams share a common property. Describe the property.
2. Determine the height of each light source on the tower.
3. Determine an equation for the path of a fifth laser beam that is to be tangent to the edge of the roof at the vertex. Where should this light source be located on the tower?
4. Consider the one laser light that does not share the common property. Keeping the location of the light source fixed, determine a new equation for the path of the laser light so that it now shares the common property. Where does it intersect the edge of the roof?

**As you respond to each question, consider the following:**

* **Are the graphs properly constructed and fully labeled?**
* **Are the points of intersection properly determined?**
* **Are the heights on the tower of the different coloured lights properly determined?**
* **Is the equation of the path of a fifth laser that is tangent to the edge of the roof at the vertex properly determined?**
* **Is the equation of the laser light not intersecting at the common point properly adjusted so that it intersects at the common point?**

**Criterion A: Knowledge and Understanding**

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| **Achievement**  **Level** | **Level Descriptor** | **Task Specific Clarification** |
| **0** | The student does not reach a standard described by any of the descriptors given below. | |
| **1-2** | The student **attempts** to make deductions when solving **simple** problems in **familiar** contexts. | The student **attempted to**:   * solve for the point(s) of intersection of each linear-quadratic system * determine the point of intersection of two linear functions * determine the height of each light source * graph the quadratic function * recognize the common property * discuss which beam does not share the common property * determine the required equations |
| **3-4** | The student **sometimes** makes **appropriate** deductions when solving **simple and more-complex** problems in **familiar** contexts. | The student **sometimes**:   * solves for the point(s) of intersection of each linear-quadratic system * determines the point of intersection of two linear functions * determines the height of each light source   The student was able to do **some** of the following:   * graph the quadratic function * recognize the common property * discusses which beam does not share the common property * determines the required equations |
| **5-6** | The student **generally** makes **appropriate** deductions when solving **challenging** problems in a **variety** of **familiar** contexts. | The student **generally**:   * solves for the point(s) of intersection of each linear-quadratic system * determines the point of intersection of two linear functions * determines the height of each light source * graphs the quadratic function * recognizes the common property * discusses which beam does not share the common property * determines the required equations |
| **7-8** | The student **consistently** makes **appropriate** deductions when solving **challenging** problems in a **variety** of contexts including **unfamiliar** situations. | The student **consistently**:   * solves for the point(s) of intersection of each linear-quadratic system * determines the point of intersection of two linear functions * determines the height of each light source * graphs the quadratic function * recognizes the common property * discusses which beam does not share the common property * determines the required equations |

**Criterion C: Communiction**

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| **Achievement**  **Level** | **Level Descriptor** | **Task Specific Clarification** |
| **0** | The student does not reach a standard described by any of the descriptors given below. | |
| **1-2** | The student shows **basic** use of mathematical language **and/or** forms of mathematical representation. The lines of reasoning are **difficult to follow**. | The student:   * does not clearly explain or justify solution * uses limited or incorrect mathematical form * uses limited labeling on graph |
| **3-4** | The student shows **sufficient** use of mathematical language **and** forms of mathematical representation. The lines of reasoning are **clear** though not always **logical** or **complete**. The student moves between different forms of representation **with some success**. | The student:   * explains or justifies the solution somewhat * uses minimal or inconsistent mathematical form * labels graphs but with some minor errors |
| **5-6** | The student shows **good** use of mathematical language **and** forms of mathematical representation. The lines of reasoning are **concise**, **logical** and **complete**. The student moves **effectively** between different forms of representation. | The student:   * explains, justifies, and show insight into the complexities of the solution * uses excellent mathematical form * clearly labels fully developed graphs |